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IMPACT OF PREOPERATIVE TRANSCATHETER ARTERIAL EMBOLIZATION ON BLOOD LOSS AND SURGERY TIME DURING ENDOSCOPIC TRANSNASAL RESECTION OF JUVENILE ANGIOFIBROMA

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Abstract

Juvenile nasopharyngeal angiofibroma is the most common benign tumor of the nasopharynx in adolescent males, often presenting with aggressive local invasion and severe, potentially life-threatening epistaxis. Its highly vascular nature complicates surgical resection, making preoperative transarterial embolization an important step to reduce intraoperative blood loss and improve outcomes. Evaluating the effectiveness of different embolization techniques is critical for optimizing endoscopic surgical treatment and minimizing complications. This study was driven by an ongoing need to improve surgical safety and efficiency, especially as endoscopic approaches become the standard of care in managing this challenging tumor.

The purpose of the study. To determine the effect of preoperative transcatheter arterial embolization on intraoperative blood loss and surgery time for endoscopic transnasal resection of juvenile nasopharyngeal angiofibroma.

Methods and materials. A retrospective analysis was conducted on thirty adolescent male patients who received surgical treatment at the University Medical Center from February 2014 to December 2023. The cohort was divided into two groups: those who underwent preoperative transcatheter arterial embolization (n = 19) and those who did not (n = 11). The characteristics compared included blood loss and the duration of surgery.

Results. Patients who underwent preoperative transcatheter arterial embolization experienced a significant reduction in intraoperative blood loss across all stages of juvenile nasopharyngeal angiofibroma. Although preoperative transcatheter arterial embolization reduced the time required for surgery, the results were not statistically significant.

Conclusions. Preoperative transcatheter arterial embolization significantly enhances surgical outcomes by effectively reducing intraoperative bleeding during the resection of juvenile nasopharyngeal angiofibroma.

Keywords: *nasopharyngeal angiofibroma, preoperative transcatheter arterial embolization, bleeding volume, surgery time, recurrence.*

Introduction

Nasopharyngeal angiofibroma (hereinafter – NPAF), also known as juvenile nasopharyngeal angiofibroma, is the most common benign nasopharyngeal tumor and accounts for around 0.5 % of all head and neck tumors [1]. Adolescent boys are the most affected group, with a frequency of almost 1 in 150,000 [2]. Despite not being disseminative or metastatic, NPAF is a locally aggressive cancer that can infiltrate critical areas such as the orbital cavity,

palate, paranasal sinuses, sphenoid bone, and even the middle cranial fossa.

NPAF differs from other angiofibromas histologically. The reticular matrix is mostly composed of collagen and multinucleated fibroblasts entangled with thin, non-contractile blood vessels. The tumor's structural features, which increase the likelihood of heavy bleeding when destroyed, make surgical resection very difficult. [3]. The primary clinical signs of NPAF are recurrent epistaxis and nasal obstruction, which can develop into uncontrollable, potentially lethal bleeding. Up to 60 % of individuals experience severe bleeding attacks that need surgery, as research indicates [4].

A comprehensive treatment is necessary to control juvenile nasopharyngeal angiofibroma (JNA). Treatment techniques are customized based on the tumor's stage, location, and unique patient features, with a focus on minimizing damage and optimizing outcomes. The primary treatment for JNA remains surgery. The advantages of endoscopic resection, including reduced morbidity [5], quicker recovery [6], and less scarring [7], have made it the preferred operation in many situations, thanks to advancements in endoscopic procedures. A study examining 71 patients who underwent endoscopic surgery between 1985 and 2019 demonstrated its efficacy and safety, yielding positive results [8]. However, for big tumors including the cerebral region, open surgical procedures may still be necessary. A recent multicenter study by Patel et al. (2023) revealed that 25 % of patients with advanced-stage JNA required open surgical approaches due to deep cerebral invasion, highlighting the limitations of endoscopic procedures in these circumstances [9].

Because JNA is vascular, preoperative transarterial embolization (pTAE) is commonly performed to reduce intraoperative blood loss. By blocking the tumor's feeding arteries, embolization reduces bleeding during surgery. Preoperative embolization reduced the amount of blood lost during surgery by an average of 200 milliliters and shortened the procedure's duration to approximately two and a half hours in a group of 20 male patients [10].

If surgical excision is not feasible, radiation therapy is utilized instead, especially for tumors with extensive cerebral growth or for patients who are not good candidates for surgery.

Although radiotherapy can slow the growth of tumors, therapy is not without danger, including the risk of cancer and damage to surrounding structures. Consequently, its use is limited to specific contexts [10]. As JNA treatment possibilities, androgen receptor targeting, hormone therapy, and chemotherapy have all been studied. However, these modalities are typically considered to be secondary rather than first-line treatments due to their unpredictable effectiveness and side effects. In the research of Thomas et al. (2017), androgen deprivation therapy (hereinafter – ADT) is presented as an adjuvant therapy for juvenile nasopharyngeal angiofibroma. ADT can help slow down the growth of the tumor, but it can also cause side effects. These endocrine conditions, including hypogonadism, low libido, etc., may impair the quality of life of the patient. The findings highlight the significance of considering these side effects while using hormone therapy to manage JNA [11]. To manage JNA most effectively, specialists such as neurosurgeons, otolaryngologists, radiation oncologists, and interventional radiologists can be involved. This multiprofessional team enhances patient outcomes by offering comprehensive treatment, from diagnosis and accurate staging to the selection of the most suitable treatments.

The purpose of this study was to establish the effect of varying preoperative transcatheter artery embolization on blood loss, operating time, and rate of recurrence for endoscopic transnasal removal of nasopharyngeal angiofibroma.

The novelty of the study lies in its direct comparison of surgical outcomes between patients with juvenile nasopharyngeal angiofibroma who underwent embolization and those who did not, over a nearly decade-long period. It provides updated evidence that preoperative transcatheter arterial embolization significantly reduces intraoperative blood loss, supporting its routine use in endoscopic surgical management.

Materials and methods

Study Design

This retrospective cohort study reviewed the medical records of thirty JNA patients treated at the Head and Neck Department of the University Medical Center in Astana, Kazakhstan. Important information included patient demographics, tumor stage (according to the Radkowski classification), intraoperative hemorrhage, surgical duration, recurrence rates, and complications.

Patient Selection

Inclusion criteria: male patients aged 12 to 17 years, confirmed JNA diagnosis through computed tomography, informed consent; Exclusion Criteria: patients whose medical records are not comprehensive, the existence of notable comorbidities or prior JNA procedures, absence of formal approval.

Preoperative Embolization

24 to 48 hours before surgery, embolization was performed using digital subtraction angiography (hereinafter – DSA). Gelatin sponges or polyvinyl alcohol particles were used to restrict the tumor's feeding arteries. Post-embolization angiograms demonstrated adequate vascular blockage.

Surgical Procedure

Under general anesthesia, this procedure was performed using endoscopic transnasal methods. The rigid endoscope's high-resolution visualization of the nasal cavity and paranasal sinuses was crucial for the precise and radical resection of the tumor. The surgeons were able to maneuver the complex regions of the nasal passages and skull base by using tilted lens endoscopes (i.e., 0°, 30°, 45°, and sometimes 70°). The duration of the procedure and the volume of blood loss were continuously monitored in real-time.

Outcome Measures: the volume of intraoperative bleeding (mL), the duration of the surgery (minutes).

Ethical approvement

The University Medical Center's local ethics committee, dated 12.04.24, and № 2024/04-022 authorized this study. This study adhered to principles aligned with the Helsinki Declaration.

Results

In this study, thirty adolescent male patients aged between 12 and 17 years were included, all presenting with the classic triad of epistaxis, unilateral nasal obstruction, and a nasopharyngeal mass indicative of juvenile nasopharyngeal angiofibroma. The histological diagnosis of angiofibroma was confirmed. The average age of the operated patients was 12-13 years (Table 1). All patients were male, and all three stages of angiofibroma according to Radkowski's classification were included in the study in both groups. All patients underwent endoscopic transnasal removal of angiofibroma, 19 of whom underwent preoperative vascular embolization.

Table 1. Characteristics of NPAF patients included in this study

	pTAE group (n = 19)	Non-pTAE group (n = 11)
Age, years (mean ± SD)	13.9 ± 2.3	12.9 ± 1.1
Sex, male/female	19/0	11/0
Angioma size, cm (mean ± SD)	4.5± 0.7	3.9 ± 0.8
Radkowski staging, n (%)		
Stage I	5 (26.3)	7 (63.6)
Stage II	11 (57.9)	3 (27.3)
Stage III	3 (15.8)	1 (9.1)

Source: compiled by the authors

Intraoperative bleeding among all stages of NPAF was considerably lower in the pre-embolization group than that in the non-preoperative embolization group (2301 vs. 3848 mL), $p<0.01$ (Table 2). The most prominent bleeding was noted in stage 3 NPAF (1217 vs. 2105 mL), with a significant difference (p <). Surprisingly, there were no recorded negative outcomes from the embolization treatments. Surgery times were consistently lower in the pTAE group than in the non-pTAE group throughout all NPAF stages (515 mL vs. 650 mL), $p > 0.05$.

Table 2. Intro-post surgery outcomes after JNA surgery with pTAE and without

Stage	Patients, n,		Blood loss volume, mL		p	Surgery duration, min		p
	pTAE	non-pTAE	pTAE	non-pTAE		pTAE	non-pTAE	
Stage I (12)	5	7	268	364	<0.01	100	150	>0.05
Stage II (14)	11	3	817	1379	<0.01	170	200	>0.05
Stage III (4)	3	1	1217	2105	<0.01	245	300	>0.05
total	19	11	2301	3848	<0.01	515	650	>0.05

No complications were reported during embolization or surgery.
Source: compiled by the authors

Discussion

This study assessed the impact of preoperative transcatheter arterial embolization on intraoperative blood loss and operative time among patients undergoing endoscopic transnasal resection of juvenile nasopharyngeal angiofibroma. Because JNA is vascular, pTAE is crucial for improving surgical outcomes by lowering the possibility of severe bleeding.

In the retrospective analysis, thirty male adolescent patients were compared between those who received pTAE (n = 19) and those who did not (n = 11). The findings demonstrated that pTAE significantly reduced intraoperative blood loss across all tumor stages, with no adverse effects observed (2301 mL vs. 3848 mL, $p < 0.01$). pTAE reduced the amount of time needed for surgery; however, the difference was not statistically significant (515 vs. 650 mL, $p > 0.05$).

This study confirms that pTAE is effective in reducing intraoperative blood loss during JNA surgery. These findings are in line with previous research by Zhang et al. [2], which demonstrated that following embolization, bleeding volumes decreased by 40-60 %. Other studies [11-13] that involved every patient on pTAE showed that it was beneficial. Even while pTAE appeared to shorten operating times, the results were not statistically significant. Similar findings were observed by Lee and Park [5], suggesting that factors such as tumor stage and surgical complexity may have a greater impact on longevity.

Although our results are consistent with other studies, they provide new evidence to support the foundation for preoperative arterial embolization, which significantly increases the risk of major bleeding [14]. Furthermore, a substantial number of patients with statistically significant results is needed to establish these approaches as a quality standard in preoperative preparation for juvenile angiofibroma, which makes our work a valid contribution.

Limitations. The small sample size (n = 30 patients) means that the findings cannot be generalized to larger populations. Likewise, the retrospective nature necessitates minimal control over variables.

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Conclusion

The treatment of juvenile nasopharyngeal angiofibromas has undergone significant changes, and endoscopic surgical excision is now frequently recommended as the treatment of choice. Preoperative transcatheter artery embolization is a crucial adjuvant that effectively reduces blood loss in the surgical treatment of JNA. Although their effect on the length of operation is currently uncertain, further improvements in surgical and embolization procedures may lead to better patient outcomes.

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ОПЕРАЦИЯ АЛДЫНДАҒЫ ТРАНСКАТЕТЕРЛІК АРТЕРИЯЛЫҚ ЭМБОЛИЗАЦИЯНЫҢ ЖАСӨСПІРІМДІК АНГИОФИБРОМАНЫҢ ЭНДОСКОПИЯЛЫҚ ТРАНСНАЗАЛЬДЫ РЕЗЕКЦИЯСЫНДАҒЫ ҚАН ЖОҒАЛТУҒА ЖӘНЕ ОПЕРАЦИЯ УАҚЫТЫНА ӘСЕРІ

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Аңдатпа

Кәмелетке толмаған мұрын-жұтқыншақтың ангиофибромасы жасөспірім ер адамдарда мұрын-жұтқыншақтың ең жиі кездесетін қатерсіз ісігі болып табылады, көбінесе агрессивті жергілікті инвазиямен және ауыр, өмірге қауіп төндіретін мұрыннан қан кетумен көрінеді. Оның жоғары тамырлы сипаты хирургиялық резекцияны қиындатады, операция алдындағы трансартериялық эмболизация операция кезіндегі қан жоғалтуды азайту және нәтижелерді жақсарту үшін маңызды қадам жасайды. Эмболизацияның әртүрлі әдістерінің тиімділігін бағалау эндоскопиялық хирургиялық емдеуді оңтайландыру және асқынуларды азайту үшін өте маңызды. Зерттеудің өзектілігі хирургиялық қауіпсіздік пен тиімділікті арттырудың тұрақты қажеттілігінен туындайды, әсіресе эндоскопиялық тәсілдер осы қиын ісікпен күресуде стандартты күтімге айналады.

Мақсаты: операция алдындағы транскатетерлік артериялық эмболизацияның операция ішілік қан жоғалтуға және жасөспірімдік мұрын-жұтқыншақ ангиофибромасының эндоскопиялық трансназальды резекциясындағы операция уақытына әсерін анықтау.

Әдістер мен материалдар: 2014 жылдың ақпанынан 2023 жылдың желтоқсанына дейін университеттің медициналық орталығында хирургиялық емдеуден өткен отыз жасөспірім ер

пациенттерге ретроспективті талдау жасалды. Когорт екі топқа бөлінді: операция алдындағы транскатетерлік артериялық эмболизация жасағандар (n=19) және ол жасалмағандар (n=11). Қан жоғалту және операцияның ұзақтығы сияқты сипаттамалар салыстырылды.

Нәтижелер: операция алдындағы транскатетерлік артериялық эмболизациядан өткен пациенттерде жасөспірімдік мұрын-жұтқыншақ ангиофибромасының барлық кезеңдерінде операция ішілік қан жоғалтудың айтарлықтай төмендеуі байқалды. Операция алдындағы транскатетерлік артериялық эмболизация операцияға кететін уақытты қысқартқанымен, нәтижелер статистикалық тұрғыдан маңызды болмады.

Қорытындылар: операция алдындағы транскатетерлік артериялық эмболизация жасөспірімдік мұрын-жұтқыншақ ангиофибромасын резекциялау кезінде операция ішілік қан кету сәтін азайту арқылы хирургиялық нәтижелерді айтарлықтай жақсартады.

Түйін сөздер: *мұрын-жұтқыншақ ангиофибромасы, операция алдындағы транскатетерлік артериялық эмболизация, қан кету көлемі, операция уақыты, рецидив.*

ВЛИЯНИЕ ПРЕДОПЕРАЦИОННОЙ ТРАНСКАТЕТЕРНОЙ АРТЕРИАЛЬНОЙ ЭМБОЛИЗАЦИИ НА КРОВОПОТЕРЮ И ВРЕМЯ ОПЕРАЦИИ ПРИ ЭНДОСКОПИЧЕСКОЙ ТРАНСНАЗАЛЬНОЙ РЕЗЕКЦИИ ЮВЕНИЛЬНОЙ АНГИОФИБРОМЫ

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Аннотация

Ювенильная назофарингеальная ангиофиброма является наиболее распространенной доброкачественной опухолью носоглотки у подростков мужского пола, часто проявляющейся агрессивной локальной инвазией и тяжелым, потенциально опасным для жизни носовым кровотечением. Ее высоковаскулярная природа осложняет хирургическую резекцию, делая предоперационную трансартериальную эмболизацию важным шагом для снижения интраоперационной кровопотери и улучшения результатов. Оценка эффективности различных методов эмболизации имеет решающее значение для оптимизации эндоскопического хирургического лечения и минимизации осложнений. Актуальность исследования обусловлена постоянной необходимостью повышения хирургической безопасности и эффективности, особенно с учетом того, что эндоскопические подходы становятся стандартом лечения при лечении этой сложной опухоли.

Цель: определить влияние предоперационной транскатетерной артериальной эмболизации на интраоперационную кровопотерю и время операции при эндоскопической трансназальной резекции ювенильной носоглоточной ангиофибромы.

Методы и материалы: был проведен ретроспективный анализ тридцати пациентов-подростков мужского пола, прошедших хирургическое лечение в Университетском медицинском центре с февраля 2014 года по декабрь 2023 года. Когорта была разделена на две группы: те, кому была проведена предоперационная транскатетерная артериальная эмболизация (n=19), и те, кому она не была проведена (n=11). Сравнивались такие характеристики, как кровопотеря и продолжительность операции.

Результаты: у пациентов, которым была проведена предоперационная транскатетерная артериальная эмболизация, наблюдалось значительное снижение интраоперационной кровопотери на всех стадиях ювенильной носоглоточной ангиофибромы. Хотя предоперационная транскатетерная артериальная эмболизация сократила время, необходимое для операции, результаты не были статистически значимыми.

Выводы: предоперационная транскатетерная артериальная эмболизация значительно улучшает результаты хирургического вмешательства, успешно снижая интраоперационное кровотечение во время резекции ювенильной носоглоточной ангиофибромы.

Ключевые слова: *ангиофиброма носоглотки, предоперационная транскатетерная артериальная эмболизация, объем кровотечения, время операции, рецидив.*

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